

REMARKS/ARGUMENTS

This reply is fully responsive to the Office Action dated 13 JULY 2007, and is filed within five - (5) months following the mailing date of the Office Action. The Commissioner is authorized to treat this response as including a petition to extend the time period pursuant to 37 CFR 1.136(a) requesting an extension of time of the number of months necessary to make this response timely filed. The method of payment and fees for petition fee due in connection therewith is enclosed.

Disclosure/Claims Status Summary:

This application has been carefully reviewed in light of the Office Action of July 13, 2007, wherein:

A. The Applicant's claim for priority to Provisional US Application No. 60/418,044 filed on 12 October 2002 was acknowledged;

B. Claims 1-42 were rejected under 35 U.S.C. § 101, as being directed to non-statutory subject matter;

C. Claims 1-42 were rejected under 35 U.S.C. § 103(a) as being unpatentable over a report for the MICRO Project 99-105 for the University of California titled "Design Methodologies for Analog and RF integrated circuits," submitted by Sangiovanni-Vincentelli (hereinafter referred to as the "Sangiovanni publication"), in view of the Applicants' own Admission (citing the Background section of the present invention); and

D. Claims 1-42 were rejected under 35 U.S.C. § 103(a) as being unpatentable over a conference proceedings submitted by Chang et al. and titled "Wavelet-Based Galerkin Method for Semiconductor Devices Simulation," Proceedings of the 1998 IEEE International Symposium on Circuits and Systems, Vol. 6, Issue 31, May to June 1998, pages 417-420 (hereinafter referred to as "the Chang publication"), in view of the Applicants' own Admission (citing the Background section of the present invention).

Claim Rejections - 35 U.S.C. § 101

B. Turning now to the Office Action, the Examiner rejected Claims 1-42 under 35 U.S.C. § 101 as being directed to non-statutory subject matter.

5 **Claims 1, 15, and 29**

In the first part of section 2-i) of the Office Action, the Examiner stated that, although the Applicants argued that the claims produce a concrete, tangible, and useful result, wherein the result is the “behavioral model of the system,” the Examiner is still unclear if, for example, the model is stored or provided to a user, etc., since the base
10 claims lack an outputting step.

RESPONSE:

After reviewing the independent Claims 1, 15, and 29, the Applicants found that these claims were, indeed, missing an outputting step or act, as noted by the Examiner and as
15 specified on the specification, and that such “outputting step or act” should be added to the independent claims in order to increase claim readability and to reduce the time and effort required of those skilled in the art to clearly understand the scope of the invention.

Therefore, the Applicants refer the Examiner to the currently amended independent
20 Claims 1, 15, and 29, wherein the Applicants have amended the claims to include an “outputting act.” The amendments to these claims are supported by the language in the specification and have an acceptable meaning of the disclosure (referring to “outputting the time-domain response of the mixed signal system to an user”). These amendments are simply additional specific statements of inventive concepts described in
25 the application as originally filed. The currently amended outputting act reads as follows:

“outputting the time-domain response of the mixed signal system to an user, whereby the user can utilize the time-domain response of the mixed signal system to evaluate the behavioral performance of the system.”

The Applicants submit that support for the current amendments to Claims 1, 15, and 29 regarding an “outputting act” can be found on the original patent application page 10, lines 1-4, where the specification states that “the present invention will be discussed herein in the context of **calculating the temporal response of mixed-signal circuits.**”

5 Furthermore, the Applicants submit that the word “temporal” is defined by the American Heritage Dictionary as, “adjective relating to, or limited by time: *a temporal dimension; temporal and spatial boundaries.*” *The American Heritage Dictionary of the English Language, Fourth Edition, Copyright 2000, by the Houghton Mifflin Company.* Thus, the Applicants assert that the term “temporal response” is equivalent to the term “time-
10 domain response.” Accordingly, the Applicants submit that the specification supports the use of an act of “outputting the time-domain response of the mixed signal system to an user, whereby the user can utilize the time-domain response of the mixed signal system to evaluate the behavioral performance of the system.”

15 In addition, the Applicants submit that after the principal inventor, Dr. George C. Valley, reviewed the original set of claims, **Dr. Valley pointed out that the term “matrix-based wavelet operator” previously used in the original specification and claims is a typographical error, and that this term “matrix-based wavelet operator” should actually read as “wavelet-based matrix operator,” since the “matrix” and “wavelet”**
20 **terms were swapped with each other by mistake.** Accordingly, the Applicants are

currently amending all the affected original claims using the term “matrix-based wavelet operator,” to include the correct term “wavelet-based matrix operator” throughout the claims. The Applicants refer the Examiner to the currently amended Claims affected by this typographical mistake which are Claims 1, 4, 5, 9- 11, 15, 18, 19, 23-25, 29, 32, 33,
25 and 37-39. Support for the correction of this typographical mistake can be found on the second and third paragraphs of the second page of a declaration under 37 CFR 1.132, signed by the inventor and submitted along with this response (as evidenced by the declaration under 37 CFR 1.132 signed by Dr. George C. Valley, included herewith as Appendix A). Furthermore, indirect support for the term “wavelet-based matrix
30 operator” may also be found in the original specification page 10 lines 19-20, where the

specification states that “In one aspect, the present invention uses the wavelet-Galerkin method to derive a matrix representative of the system to be analyzed.”

5 Currently amended Claims 1, 15, and 29 are directed toward a practical application, and thus, toward statutory subject matter within the meaning of 35 U.S.C. 101.

10 The Applicants remind the Examiner that the utility requirement in §101 of the title 35, U.S.C. states that “the examination procedures for computer-related inventions classifies the claim invention as being statutory subject matter when the process or method performs independent physical acts (post-computer process activity) or manipulates data representing physical objects or activities to achieve a practical application (pre-computer process activity).” See MPEP 2107. Furthermore, “the examination procedures for computer-related inventions further state that a claim

15 invention is classified as being statutory subject matter when the process or method does not merely manipulate an abstract idea or does not solve a purely mathematical problem without any limitation to a practical application.” In addition, the Federal Circuit court stated that a claim is limited to a practical application when the method, as claimed, produces a concrete, tangible and useful result. *AT&T v. Excel Communications, Inc.*,
20 172 F.3d at 1358.

The Applicants assert that the current independent Claims 1, 15, and 29 produce a concrete, tangible, and useful result (i.e., time-domain response of a mixed signal system), accordingly these independent claims are directed toward a practical application

25 under the Federal Circuit court ruling, and thus, toward statutory subject matter within the meaning of 35 U.S.C. 101. Furthermore, the Applicants assert that as required by § 101, the present invention manipulates data representing physical objects (i.e., wavelet-based matrix operator representation of time-domain equations characterizing a mixed signal system), and that the present invention also performs activities (i.e.,

30 generating a wavelet-based matrix operator, selecting a number of wavelets, iteratively

applying the wavelet-based matrix operator, and outputting the time-domain response of the mixed signal system to an user) **to achieve a practical application by producing a concrete, tangible, and useful result** (i.e., time-domain response of a mixed signal system).

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The Applicants submit that Claims 1, 15, and 29 recite a method, an apparatus, and a computer program product, respectively, for simulating a time-domain response of a mixed-signal system by iteratively applying the wavelet-based matrix operator over clock cycles to calculate a time-domain response of the mixed signal system. Thus, these
10 claims are directed toward a method that produces a concrete, tangible and useful result, i.e., the result being the time-domain response of the mixed signal system.

Therefore, Claims 1, 15, and 29 are directed toward a method, an apparatus, and a computer program product, respectively, that produce a concrete, tangible and useful
15 result, i.e., the result being the time-domain response of the mixed signal system, whereby a user can utilize the time-domain response of the mixed signal system to evaluate the behavioral performance of the system. Therefore, the Applicants submit that Claims 1, 15, and 29 are directed toward a practical application with a useful and concrete result, and thus are directed toward statutory subject matter within the meaning
20 of 35 U.S.C. § 101.

In the second part of section 2-i) of the Office Action, the Examiner stated that the Applicants previously stated that claims 29-42 refer to “a computer program product comprising a computer readable medium for use in a computer system with the
25 computer program product having computer readable means,” and that the preamble of Claims 29-42 do not include exactly the language recited above by the Applicants. The Examiner further stated that the preamble of Claims 29-42 reads as follows: “A computer program product for simulating a mixed-signal system comprising a computer readable medium having means, encoded thereon for,” and that the claims are missing the
30 part referring to “for use in a computer system with the computer program product having

computer readable means.” Then, the Examiner suggested amending the claims using the following example of a proper computer program product claim: A computer program product embodied on a computer readable medium and comprising code that, when executed, causes a computer to perform acts of: Function A, Function B, etc.

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RESPONSE:

The Applicants amended the preamble of the computer program product root Claim 29, in order to incorporate the proper computer program product preamble as previously suggested by the Examiner. The preamble of root Claim 29 has been amended as follows:

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“A computer program product for simulating a mixed-signal system, the computer program product embodied on a computer readable medium and comprising code that, when executed, causes a computer to perform the acts of:”

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The Applicants submit that these amendments are simply additional specific statements of inventive concepts described in the application as originally filed, and they do not change the scope of these claims. The Applicants respectfully request that the Examiner accept the currently amended set of claims as a replacement for the original set of claims submitted with the patent application. The Applicants believe that the new set of amended claims overcome the rejections cited by the Examiner under 35 U.S.C. § 101.

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In light of these amendments and the remarks made above, the Applicants believe Claims 1-42, to be allowable in their newly amended form, and respectfully request that these rejections of Claims 1-42 under 35 U.S.C. § 101 be withdrawn.

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Furthermore, the Applicants submit that Claims 2-14 are dependent upon Claim 1, Claims 16-28 are dependent upon Claim 15, and Claims 30-42 are dependent upon Claim 29. For at least the reasons given above, the Applicants submit that Claims 1, 15, and 29

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are directed to statutory subject matter within the meaning of 35 U.S.C. § 101. Therefore, in addition to the reasons set forth above, the Applicants submit that Claims 2-14, 16-28, and 30-42 are also directed to statutory subject matter within the meaning of 35 U.S.C. § 101 at least based on their dependence upon an allowable base claim.

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Claim Rejections - 35 U.S.C. § 103(a)

Examiner's rejections of Claims 1-42 over the Sangiovanni publication, in view of the Applicants' own admission

10 C. In section 5 of the Final Office Action, the Examiner rejected Claims 1-42 under 35 U.S.C. § 103(a) as being unpatentable over the Sangiovanni publication, in view of the Applicants' own Admission.

Claims 1, 15, and 29

15 In the Final Office Action, dated July 13, 2007, the Examiner rejected independent Claims 1, 15, and 29 under 35 U.S.C. 103(a) as being unpatentable over the Sangiovanni publication, in view of the Applicants' own Admission. However, the Applicants have submitted with this Request for Continued Examination (RCE) a new set of amended claims, which the Applicants believe overcome the art cited by the Examiner.

20 Please note That the Applicants have amended independent Claims 1, 15, and 29 in order to reduce the confusion created by the broad root claims, to improve the claims readability, to reduce the time and effort required of those skilled in the art to clearly understand the scope of the claim language, to more clearly define the present invention, and to avoid further confusion on the Examiner's part regarding the teachings of the present invention. These amendments are simply additional specific statements of inventive concepts described in the application as originally filed. These proposed amendments do not affect the scope of the claims. Furthermore, these amendments have been written along with the full collaboration of the inventor, Dr. George C. Valley, in order to preserve the invention. In addition, Claims 4, 5, 8-11, 14, 18, 19, 22-28, 32, 33, 30 36-39, and 42 have also been amended in order to preserve the uniformity of the claim

language throughout the claims and to satisfy antecedent basis. A listing of the proposed amendments is presented on pages 2 to 11 of this response communication.

In order to more clearly define the present invention and to avoid any confusion regarding the teachings of the present invention, the Applicants amended the previous “act of iteratively applying the wavelet-based matrix operator” to read as follows:

“iteratively applying the wavelet-based matrix operator within each clock period and sequentially over a large number of clock cycles to calculate a time-domain response of the mixed signal system, wherein calculation within each clock period is weakly non-linear, and wherein the calculation within each clock period is performed by matrix multiplication”

As previously stated and repeated here for clarity, the Applicants submit that the term “temporal response” is equivalent to the term “time-domain response;” that the specification supports to “calculate a time-domain response of the mixed signal system” (referring to original patent application page 10, lines 1-4, where the specification states that “the present invention will be discussed herein in the context of calculating the temporal response of mixed-signal circuits”); and that the first named inventor, Dr. George C. Valley, stated that the term “matrix-based wavelet operator” should actually read as “wavelet-based matrix operator,” since the “matrix” and “wavelet” terms were swapped with each other by mistake, where the support for the correction of this typographical mistake can be found on the second and third paragraphs of page 2 of the attached declaration under 37 CFR 1.132 signed by the inventor.

Furthermore, the Applicants submit that support for the current amendments to Claims 1, 15, and 29 regarding “wherein calculation within each clock period is weakly non-linear, and wherein the calculation within each clock period is performed by matrix multiplication” can be found in the original patent application page 10, lines 9-11, where the specification states that “The present invention provides a technique in which a

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system simulation is broken up into clock periods, and the calculation within each clock period, which is weakly non-linear, is performed by matrix multiplication.” Additional support for these amendments can be found in the original patent application page 11, paragraph 65, and the original claims.

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The Applicants respectfully request that the Examiner accept the newly amended set of claims as a replacement for the original set of claims submitted with the patent application. The Applicants believe this new set of amended claims overcome the rejections cited by the Examiner during the Final Office Action, dated July 13, 2007.

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Regarding the rejection of Claims 1, 15, and 29 over the Sangiovanni publication, in view of the Applicants’ own admission

Upon a thorough review of the Sangiovanni publication and the Applicants’ own admission, the Applicants submit that: (I) the combination of the Sangiovanni publication and the Applicants’ own admission does not disclose each element of the independent Claims 1, 15, and 29; (II) the prior art references do not contain any suggestion or motivation express or implied that they be combined; and (III) the present invention provides a method which presents a solution to an unsolved need in a crowded art, and as such, the present invention should be regarded as significant and thus, non obvious.

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I. All elements are not suggested by the reference teachings.

The cited prior art does not establish a prima facie case of obviousness

In order to establish a *prima facie* case of obviousness, the Examiner must set forth an argument that provides (1) one or more references (2) that were available to the inventor and (3) that teach (4) a suggestion to combine or modify the references, (5) the combination or modification of which would appear to be sufficient to have made the claimed invention obvious to one of ordinary skill in the art. Importantly, the teaching or suggestion to make the claimed combination must be found in the prior art, not in the Applicant’s disclosure. *In re Vaeck*, 947 F.2d 4888, 20 USPQ2d 1438 (Fed. Cir. 1991).

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Further, the CCPA has subsequently added that the prima facie case requires that the reference teachings “appear to have suggested the claimed subject matter.” *In re Rinehart*, 531 F.2d 1048 (C.C.P.A. 1976).

5 The Applicants assert that the Examiner has failed to establish references that, if combined, teach each of the elements of the claimed invention. More specifically, the cited prior art fails to teach the elements of “**iteratively applying the wavelet-based matrix operator within each clock period** and sequentially over a large number of clock cycles to calculate a time-domain response of the mixed signal system, **wherein**
10 **calculation within each clock period is weakly non-linear, and wherein the calculation within each clock period is performed by matrix multiplication**” (emphasis added), as recited on independent Claims 1, 15, and 29 of the present invention.

15 The Applicants assert that, in contrast to the present invention, the combination of the Sangiovanni publication with the four references cited on the Applicants’ own disclosure does not teach or even suggests “**applying a wavelet-based matrix operator within each clock period,**” since all of the prior references that work with wavelets simulating non-linear circuits and that are cited on the Applicants’
20 own admission exclusively apply the wavelet operator across the entire time interval of the simulation without breaking the computations to **iteratively applying the wavelet-based matrix operator within each clock period and sequentially over a large number of clock cycles** throughout the duration of the entire simulation. Furthermore, none of the references cited in the Applicants’ own
25 disclosure teach or even suggest that the calculation within each clock period is weakly non-linear, and that the calculation within each clock period is performed by matrix multiplication.

In addition, the Applicants further submit the following statements provided by
30 the first named inventor of the present application, Dr. George C. Valley, an

expert in the field of numerical solution of time-domain equations for physical systems who received a Ph. D in Physics from the University of Chicago in 1971, and who has conducted research in the numerical solution of time-domain equations for physical systems for the last 20 years (as evidenced by the
5 declaration under 37 CFR 1.132 signed by Dr. George C. Valley, included herewith as Appendix A).

“The Sangiovanni-Vincentelli publication is not relevant to the claims of the present application because it considers just analog or RF circuits and
10 contains no time-domain simulations. An invention according to the present application applies to time-domain simulation of mixed signal circuits - circuits with both digital and analog or RF subsets. In particular, the Sangiovanni-Vincentelli publication will not involve the highly discontinuous non-linear operations of the digital clock that are one
15 of the main reasons the method claimed in the present application is needed.”

“Upon a review of the Office Action dated August 13, 2007 (for the present application), I believe that the Examiner is confused when he
20 states that the invention uses a larger clock time period. The clock time period is a property of the circuit to be simulated and not of the method disclosed in the present application. The method in the present application uses the wavelet-based matrix operator approach in a single clock period, which does not exist in any of the literature that I or
25 the Examiner cited as prior art.”

Regarding the Examiner's statements on section 2 iv), where the Examiner stated that the Applicants' own admission discloses the use of wavelets to characterize a system, as well as iteratively applying a method over a series of
30 clock cycles, the Applicants submit that there are multiple methods to characterize

a system and that the fact that Wavelets are used to solve differential equations is well known, but that does not mean that those methods are equivalent or even similar to the method disclosed by the present invention. **The Applicants suggest that the Examiner should actually read the prior art in question** (referring to the Applicants' own admission) **before the Examiner formulates his rejections based exclusively on the general concept of using wavelets to characterize a system.**

The Applicants submit that the fact that wavelets are used to solve differential equations is well known, however, none of the cited prior art discloses how to make a matrix operator to use over a clock period to speed up the simulation of mixed signal circuits, which are defined to include nonlinear analog components and sharp time variations at the clock period of the digital part of the circuit. The Applicants assert that the wavelet methods disclosed on the Applicants' own admission do not teach or even suggest using the wavelet-base matrix operator approach in a single clock period by iteratively applying the wavelet-based matrix operator within each clock period and sequentially over a large number of clock cycles to calculate a time-domain response of the mixed signal system.

Furthermore, **the Applicants request that the Examiner indicate exactly where (page number, column number, and line number)** in the Sangiovanni publication, or the Opal et al. reference, or the Schreier and Zhang reference, or the Zhou et al. reference, or/and the Meliopoulos and Lee reference (referring to the background section of the present invention), **the Examiner finds that the limitation of** "iteratively applying the wavelet-based matrix operator within each clock period and sequentially over a large number of clock cycles to calculate a time-domain response of the mixed signal system, wherein calculation within each clock period is weakly non-linear, and wherein the calculation within each clock period is performed by matrix multiplication," as is disclosed in Claims 1, 15, and 29, **is taught, disclosed or suggested.**

Therefore, the Applicants assert that the Sangiovanni publication, in combination with the prior art disclosed on the background section of the present invention, and with the knowledge of one skilled in the art, does not teach, disclose, or suggest all of the limitations of the currently amended Claims 1, 15, and 29.

In light of the current amendments and the remarks made above, the Applicants believe Claims 1, 15, and 29, to be allowable in their newly amended form for at least the foregoing reasons, and respectfully request that these rejections of Claims 1, 15, and 29 under 35 U.S.C. § 103(a) be withdrawn.

II. The prior art references do not contain any suggestion or motivation express or implied that they may be combined

There is no suggestion or motivation to combine references.

Under MPEP § 2143.01, a suggestion or motivation to combine references must be present to prove a *prima facie* case of obviousness. This can be proven if the prior art suggests the desirability of the claimed invention. MPEP § 2143.01. The fact that the references can be combined or modified is not sufficient to establish a *prima facie* case of obviousness. *Id.* Also, the fact that the claimed invention is within the capabilities of one of ordinary skill in the art is not sufficient by itself to establish a *prima facie* case of obviousness. *Id.*

(a) The prior art must suggest the desirability of the claimed invention.

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so. *In re Kahn*, 441 F.3d 977, 986, 78 USPQ2d 1329, 1335 (Fed. Cir. 2006). A rejection under 35 U.S.C. § 103(a) is improper when it is based upon a combination of references that teaches every element of a claimed invention but lacks a motivation to combine. *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58

(Fed. Cir. 1998). The court in *In re Fulton* emphasized that the proper inquiry is “whether there is something in the prior art as a whole to suggest the *desirability*, and thus the obviousness, of making the combination,” *In re Fulton*, 391 F.3d 1195, 73 USPQ2d 1141 (Fed. Cir. 2004) at 1145-46.

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The Applicants submit that there is no desirability of combining the teachings of the Sangiovanni publication which considers just analog or RF circuits working exclusively with frequency constrains (referring to the abstract and result figure 3 of the Sangiovanni publication) and which contains no time-domain simulations, with the teachings of the prior art disclosed on the background section of the present invention, which work exclusively with time-domain constrains and simulations (representations) of systems (referring to paragraphs 6 and 7 of the background section of the present invention). **The Applicants believe that there is no desire from someone on the field of numerical solution of time-domain equations for physical systems to combine their teachings with the findings of a frequency domain document, and vice versa.**

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(b) The fact that the references can be combined or modified is not sufficient to establish a *prima facie* case of obviousness.

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The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Although a prior art device “may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so.” 916 F.2d at 682, 16 USPQ2d at 1432.). See also *In re Fritch*, 972 F.2d 1260, 23 USPQ2d 1780 (Fed. Cir. 1992). The Applicants submit that although it maybe possible to combine some of the teachings disclosed by the Sangiovanni publication with some of the teachings of the prior art in the background section of the present invention, the combination is neither desirable nor suggested by the Sangiovanni publication or the prior art in the background section of the present invention.

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Regarding the Examiner's statements on section 2 ii)

The Applicants submit that the Examiner based his motivation to combine the references in the abstract of the Sangiovanni publication. However, the Applicants did not find anything on the abstract of the Sangiovanni publication that even suggest to
5 combine the frequency response method taught by the Sangiovanni publication with the time-domain methods of the background section of the present invention.

The Applicants suggest that the Examiner provide a direct quote from the abstract of the Sangionvanni publication where the Examiner is exactly finding the motivation to
10 combine the frequency domain method of the Sangionvanni publication with the time-domain methods of the Applicants' own admission. The Applicants further submit that the four references on the Applicants' own admission, which correspond to Opal et at. (referring to paragraph [0007] line 4 of the AOA), Schreier and Zhang (referring to paragraph [0007] line 9 of the AOA), Zhou et al. (referring to paragraph [0007] line 17 of
15 the AOA), and Meliopoulos and Lee (referring to paragraph [0007] lines 17-18 of the AOA) do not suggest themselves any suggestion or motivation, express or implied, that they be combined with each other or with the Sangionvanni. Therefore, **the Applicants request that the Examiner indicate exactly where in the Opal et at. reference, the Schreier reference, the Zhang reference, the Zhou et al. reference, the Meliopoulos reference, and the Lee reference (page number, paragraph number, and line numbers), the Examiner found the motivation to combine** all of these references with
20 the Sangiovanni publication.

Furthermore, the Examiner stated that even though the Applicants argued that there is
25 no suggestion to combine the references, the Examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or **in the knowledge generally available to one of ordinary skill in the art** (emphasis added here by the
30 Examiner). This statement seems to suggest that the Examiner is one of ordinary

skill in the art of numerical solution of time-domain equations for physical systems, since the motivation to combine was not found by the Applicants anywhere in the references cited by the Examiner, then the suggestion or motivation to combine these references together must be found in the knowledge generally available to one of ordinary skill in the art. Thus, the Examiner must be implying that the Examiner is one of ordinary skill in the art, and a such, the Applicants respectfully request that if the Examiner is submitting expert opinions concerning numerical solution of time-domain equations for physical systems, that **the Examiner needs to support his opinions with an official proof of his expertise qualifications as a person of ordinary skill in the art of numerical solution of time-domain equations for physical systems.**

Given that there are no suggestions or motivations in the references themselves and that such teachings of the claimed limitations should not be based on the Applicants' disclosure, then it must be assumed that such suggestion or motivation to interpret (and hence, modify) the time-domain teachings of the Opal et al. reference, the Schreier reference, the Zhang reference, the Zhou et al. reference, the Meliopoulos reference, and the Lee reference and combine these references with the frequency-domain teachings of the Sangiovanni publication came from the general knowledge of the Examiner. Therefore, **the Applicants request that an affidavit from the Examiner be provided to the Applicants as required under 37 CFR 1.104(d)(2) to support the Examiner's rejections**, stating specifically the facts that support the Examiner's assertions as a person of ordinary skill in the art of numerical solution of time-domain equations for physical systems.

Title 37 CFR 1.104(d)(2) specifically states: "When a rejection in an application is based on facts within the personal knowledge of an employee of the Office, the data shall be as specific as possible, and the reference must be supported, when called for by the applicant, by the affidavit of such employee, and such affidavit shall be subject to

contradiction or explanation by the affidavits of the applicant and other persons.”

(c) The fact that the claimed invention is within the capabilities of one of ordinary skill in the art is not sufficient by itself to establish a *prima facie* case of obviousness.

A statement that modifications of the prior art to meet the claimed invention would have been “well within the ordinary skill of the art” at the time the claimed invention was made” because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993). Merely the level of skill in the art cannot be relied upon to provide the suggestion to combine references. *Al-Site Corp. v. VSI Int’l Inc.*, 174 F.3d 1308, 50 USPQ2d 1161 (Fed. Cir. 1999).

Here, there is no suggestion or desirability expressed by the Sangiovanni publication or any of the references on the prior art on the background section of the present invention to combine the frequency domain teachings of the Sangiovanni publication with the time-domain methods taught by the prior art on the background section of the present invention.

Therefore, the Applicants submit that there is nothing more than the combination being within the ordinary skill of the art, which is not sufficient to prove a *prima facie* case of obviousness.

III. The present invention provides a method which presents a solution to an unsolved need in a crowded art

The present invention provides a method which presents a solution to an unsolved need in a crowded art, and as such, the present invention should be regarded as significant and thus, non obvious.

5 The court has ruled that improvements on crowded prior art are patentable. *Berkely Park Clothes, Inc. v. Firma Shaeffer-Homberg GMBH*, 217 U.S.P.Q. (BNA) 388 (1981). In addressing such an issue, the court stated that “like many inventions, the new design is not an astonishing breakthrough or a new technology. Nevertheless, it is a significant non-obvious improvement on prior art. Sometimes achievement is revolutionary, but
10 more often an inventor begins where others leave off and perceives the vital forward step to which predecessors have been blind. The courts must take care to not conclude that an innovation is obvious because it has become obvious by hindsight.” *Berkely Park Clothes, Inc. v. Firma Shaeffer-Homberg GMBH*, 217 U.S.P.Q. (BNA) 388 (1981). The patent at issue in *Berkely*, U.S. Patent No. 3,872,554, was a closure for clothing in an area
15 of crowded prior art. The court addressed the crowded art issue specifically, stating that “the field is a crowded field. It is an old field..... The non-obviousness is shown rather dramatically by the rather surprising list of earlier patents of closures of this type, none of which approach this one in its conception.” See *Berkely* (emphasis added). As in the case of *Berkely*, the present invention is in a crowded field, where the non-obviousness
20 can be shown by the rather surprising list of earlier patents, none of which approach the present application in its conception. As was the case in *Berkely*, the present improvement may not be revolutionary, but it is a significant non-obvious improvement on prior art.

25 The Applicants submit that the present invention provides a solution to an unsolved need in a crowded art, and as such, the present invention should be regarded as significant and thus, non-obvious. The present invention is classified in the crowded art of techniques for time-domain simulation of mixed-signal non-linear systems. Specifically the present invention relates to a technique for using a wavelet operator to simulate the time-domain

performance of mixed-signal circuits (referring to the present invention page 1 lines 9-10).

In the crowded art of mixed-signal system time-domain simulation and modeling, there are several methods to create a behavioral model (time-domain response) for a mixed-signal non-linear system, however they have several problems that the present invention overcomes. The Applicants submit that the inventor of the present invention, Dr. George C. Valley, who is an expert in the field of numerical solution of time-domain equations for physical systems for the last 20 years, states the following:

“Previously, wavelet techniques could not be applied to mixed signal circuits. This is because previous wavelet techniques (prior to the present application) using 64 wavelets per clock period for 2^{14} clock periods yields a requirement of over 1 million wavelets for the full circuit simulation. Such methods would be very slow because of the number of wavelets involved and cannot converge when nonlinear effects are included because the nonlinear effects in the first clock period influence the response in all subsequent time periods.”

Furthermore, an invention according to the present application is faster than the time marching algorithms because the discontinuity is modeled at the clock period in the circuit response with a single wavelet basis at each iteration, while the time-marching algorithm must subdivide into many hundredths (100s) of time steps to accurately march up the nearly discontinuous change in the state variables at the clock period.”

In contrast with the prior art, the Applicants submit that the present invention provides a technique in which a system simulation is broken up into clock periods, and the calculation within each clock period, which is weakly non-linear, is performed by wavelet-based matrix operator multiplication. The Applicants further submit that the

entire simulation can be performed by repeating this process for the required number of clock periods (iteratively applying the wavelet-based matrix operator within each clock period and sequentially over a large number of clock cycles to calculate a time-domain response of the mixed signal system). The Applicants emphasize that the technique disclosed in the independent claims is much faster than the time-marching algorithms for the same accuracy, since the time-marching algorithms require small time steps to simulate the discontinuous non-linearity (referring to page 10 paragraph [0061] of the present invention).

10 **Regarding the Examiner's statements on section 2 vi)**, where the Examiner stated that "the Examiner is puzzled by the Applicants' assertion that the claimed invention is significant and therefore non-obvious, since significance is not a determination of patentability," the Applicants remind the Examiner that the court has ruled that improvements on crowded prior art are patentable. *Berkely Park*
15 *Clothes, Inc. v. Firma Shaeffer-Homberg GMBH*, 217 U.S.P.Q. (BNA) 388 (1981). Furthermore, the Applicants respectfully refer the Examiner to the statements above.

Regarding the Examiner's statements on section 2 vii), the Applicants submit
20 the following statements provided by the first named inventor of the present application, Dr. George C. Valley, an expert in the field of numerical solution of time-domain equations for physical systems for the last 20 years (as evidenced by the declaration under 37 CFR 1.132 signed by Dr. George C. Valley, included herewith as Appendix A).

25

"Upon a review of the Office Action dated August 13, 2007 (for the present application), I believe that the Examiner is confused when he states that the invention uses a larger clock time period. The clock time period is a property of the circuit to be simulated and not of the method
30 disclosed in the present application. The method in the present application

uses the wavelet-based matrix operator approach in a single clock period, which does not exist in any of the literature that I or the Examiner cited as prior art. Because the wavelets are fit to the basic response of the circuit in the clock period, a rather small number of wavelets can be used in each clock period. The amount of time taken by the simulation is proportional to the number of wavelets in the method (according to the present application) and to the number of time steps needed in a clock period in the time-marching method. However, **the number of time steps in the time marching method must be orders of magnitude greater than the number of wavelets for the same accuracy, as it can be seen in figures 5 and 6 of the present application** (emphasis added), where several simulations were performed comparing the time marching method against the wavelet method disclosed in the present application. **The simulations shown in figures 5 and 6 indicate that the typical number of time marching steps was much larger than the number of wavelets used for the same accuracy** (emphasis added).”

For the foregoing reasons the Applicants respectfully believe that the present invention provides a solution to an unsolved need in a crowded art, and as such, the present invention should be regarded as significant and thus, non obvious under the court ruling that improvements on crowded prior art are patentable. *Berkely Park Clothes, Inc. v. Firma Shaeffer-Homberg GMBH*, 217 U.S.P.Q. (BNA) 388 (1981).

In light of the current amendments and the remarks made above, the Applicants believe that Claims 1, 15, and 29 in their currently amended form, are patentable over the combination of prior art references and respectfully request that this rejection of Claims 1, 15, and 29 under 35 U.S.C. §103(a) be withdrawn.

Claim Rejections - 35 U.S.C. § 103(a)

Examiner's rejections of Claims 1-42 over the Chang publication, in view of the Applicants' own admission

D. In section 6 of the current Office Action, the Examiner rejected Claims 1-42 under 35 U.S.C. § 103(a) as being unpatentable over the Chang publication, in view of the Applicants' own admission.

Claims 1, 15, and 29

In the Final Office Action, dated July 13, 2007, the Examiner rejected independent Claims 1, 15, and 29 under 35 U.S.C. 103(a) as being unpatentable over the Chang publication, in view of the Applicants' own Admission. However, the Applicants have submitted with this Request for Continued Examination (RCE) a new set of amended claims, which the Applicants believe overcome the art cited by the Examiner.

Regarding the rejection of Claims 1, 15, and 29 over the Chang publication, in view of the Applicants' own admission

Upon a thorough review of the Chang publication and the Applicants' own admission, the Applicants submit that: (I) the combination of the Chang publication and the Applicants' own admission does not disclose each element of the independent Claims 1, 15, and 29; (II) the prior art references do not contain any suggestion or motivation express or implied that they be combined; and (III) the present invention provides a method which presents a solution to an unsolved need in a crowded art, and as such, the present invention should be regarded as significant and thus, non-obvious.

I. All elements are not suggested by the reference teachings.

The cited prior art does not establish a prima facie case of obviousness

In order to establish a *prima facie* case of obviousness, the Examiner must set forth an argument that provides (1) one or more references (2) that were available to the inventor and (3) that teach (4) a suggestion to combine or modify the references, (5) the combination or modification of which would appear to be sufficient to have made the

claimed invention obvious to one of ordinary skill in the art. Importantly, the teaching or suggestion to make the claimed combination must be found in the prior art, not in the Applicant's disclosure. *In re Vaeck*, 947 F.2d 4888, 20 USPQ2d 1438 (Fed. Cir. 1991). Further, the CCPA has subsequently added that the prima facie case requires that the reference teachings "appear to have suggested the claimed subject matter." *In re Rinehart*, 531 F.2d 1048 (C.C.P.A. 1976).

The Applicants assert that the Examiner has failed to establish references that, if combined, teach each of the elements of the claimed invention. More specifically, the cited prior art fails to teach the elements of "**iteratively applying the wavelet-based matrix operator within each clock period** and sequentially over a large number of clock cycles to calculate a time-domain response of the mixed signal system, **wherein calculation within each clock period is weakly non-linear, and wherein the calculation within each clock period is performed by matrix multiplication**" (emphasis added), as recited on independent Claims 1, 15, and 29 of the present invention.

The Applicants assert that, in contrast to the present invention, the combination of the Chang publication with the four references cited on the Applicants' own disclosure does not teach or even suggests "**applying a wavelet-based matrix operator within each clock period**," since all of the prior references that work with wavelets simulating non-linear circuits and that are cited on the Applicants' own admission exclusively apply the wavelet operator across the entire time interval of the simulation without breaking the computations, like the present invention does, to **iteratively applying the wavelet-based matrix operator within each clock period and sequentially over a large number of clock cycles** throughout the duration of the entire simulation. Furthermore, none of the references cited on the Applicants' own disclosure teach or even suggest that the calculation within each clock period is weakly non-linear, and that the calculation within each clock period is performed by matrix multiplication.

In addition, the Applicants further submit the following statements provided by the first named inventor of the present application, Dr. George C. Valley, an expert in the field of numerical solution of time-domain equations for physical systems for the last 20 years (as evidenced by the declaration under 37 CFR 1.132 signed by Dr. George C. Valley, included herewith as Appendix A).

Regarding the Chang publication, **the method disclosed in the present application uses the Galerkin method only within a clock period** (as disclosed on Claims 1, 15, and 29) to determine the best Wavelet basis for the wavelet-based matrix operator. **Alternatively, the Chang publication uses the Galerkin method to solve a spatial boundary value problem, not a time-domain initial value problem** (referring to page VI-419, section 5 of the Chang publication). **The Galerkin method is completely inapplicable to time-domain initial value problems.**

“The fact that Wavelets are used to solve differential equations is well known. The fact that Galerkin’s method is used to solve differential equations is well known. However, **none of the cited prior art, to the best of my knowledge, discloses how to make a matrix operator to use over a clock period to speed up the simulation of mixed signal circuits,** which are defined to include nonlinear analog components and sharp time variations at the clock period of the digital part of the circuit.”

“**The Chang publication uses two boundary conditions at both ends of the semiconductor device because it is a Galerkin method.** It is analogous to the method (in the present application) in the time domain over a single clock period, but in no way analogous to the method (in the present application) over the entire time domain. **The Galerkin method presented in the Chang publication cannot be used for time domain**

simulation over the entire time domain because there is no known boundary condition at the final time of the simulation.

Therefore, **the Applicants request that the Examiner indicate exactly where**
5 **(page number, column number, and line number)** on the Chang publication, or the Opal et al. reference, or the Schreier and Zhang reference, or the Zhou et al. reference, or/and the Meliopoulos and Lee reference (referring to the background section of the present invention), the Examiner finds that the limitation of “iteratively applying the wavelet-based matrix operator **within each**
10 **clock period** (emphasis added) and sequentially over a large number of clock cycles to calculate a time-domain response of the mixed signal system, wherein calculation within each clock period is weakly non-linear, and wherein the calculation within each clock period is performed by matrix multiplication,” as is disclosed in Claims 1, 15, and 29, is taught, disclosed or suggested.

15 Therefore, the Applicants assert that the Chang publication, in combination with the prior art disclosed on the background section of the present invention, and with the knowledge of one skilled in the art, does not teach, disclose, or suggest all of the limitations of the currently amended Claims 1, 15, and 29.

20 In light of the current amendments and the remarks made above, the Applicants believe Claims 1, 15, and 29, to be allowable in their newly amended form for at least the foregoing reasons, and respectfully request that these rejections of Claims 1, 15, and 29 under 35 U.S.C. § 103(a) be withdrawn.

25 **II. The present invention provides a method which presents a solution to an unsolved need in a crowded art**

The present invention provides a method which presents a solution to an unsolved need in a crowded art, and as such, the present invention should be regarded as significant and thus, non obvious.

- 5 The court has ruled that improvements on crowded prior art are patentable. *Berkely Park Clothes, Inc. v. Firma Shaeffer-Homberg GMBH*, 217 U.S.P.Q. (BNA) 388 (1981).

As previously stated and repeated here for clarity, the Applicants submit that the present invention provides a solution to an unsolved need in a crowded art, and as such, the
10 present invention should be regarded as significant and thus, non obvious. The present invention is classified in the crowded art of techniques for time-domain simulation of mixed-signal non-linear systems. Specifically the present invention relates to a technique for using a wavelet operator to simulate the time-domain performance of mixed-signal circuits (referring to the present invention page 1 lines 9-10).

15 In the crowded art of mixed-signal system time-domain simulation and modeling, there are several methods to create a behavioral model (time-domain response) for a mixed-signal non-linear system. However they have several problems that the present invention overcomes. The Applicants refer the Examiner to the comments above
20 regarding solving the problems of previous methods and providing a solution to an unsolved need in this crowded art. (referring to pages 29 to 31 of this Office Action response communication).

In contrast with the Chang document and with the prior art on the Applicants' own
25 admission, the Applicants submit that the present invention provides a novel technique in which **a system time-domain simulation is broken up into clock periods, and the calculation within each clock period, which is weakly non-linear, is performed by a wavelet-based matrix operator multiplication.** The Applicants further submit that the entire simulation can be performed by repeating this process for the required number of
30 clock periods (iteratively applying the wavelet-based matrix operator within each clock

period and sequentially over a large number of clock cycles to calculate a time-domain response of the mixed signal system). The Applicants emphasize that the technique disclosed on the independent claims is much faster than the time-marching algorithms for the same accuracy, since the time-marching algorithms require small time steps to simulate the discontinuous non-linearity (referring to page 10 paragraph [0061] of the present invention, and the time-domain simulations illustrated in figures 5 and 6 of the present invention).

Regarding the Examiner's statements on section 2 ix)

The Applicants apologize for the confusion caused by the previous response arguments, where the Applicants were merely attempting to state that the present invention is able to simulate a mixed-signal system in a realistic amount of time (referring to minutes or hours depending on the length of the simulation) but **the present invention is not able to simulate a mixed-signal system in actual "real-time."** In contrast, the Applicants submit that the wavelet-based Galerking Method for semiconductor devices simulation, as particularly taught by the Chang publication, requires a large number of wavelet bases for each iteration (referring to Table 1 on page VI-520), which makes the method taught by the Chang publication unsuitable to simulate a mixed-signal system in a realistic amount of time (referring to weeks or months depending on the length of the simulation, as opposed to minutes and hours). Furthermore, the Chang publication requires two boundary conditions at both ends of the semiconductor device being analyzed, because the Chang publication consists mainly of a Galerkin method. **Therefore, the Galerkin method presented in the Chang publication cannot be used to calculate a time-domain response over an entire time domain because there is no known boundary condition at the final time of the simulation.**

For the foregoing reasons the Applicants respectfully believe that the present invention provides a solution to an unsolved need in a crowded art, and as such, the present invention should be regarded as significant and thus, non obvious under the court ruling

that improvements on crowded prior art are patentable. *Berkely Park Clothes, Inc. v. Firma Shaeffer-Homberg GMBH*, 217 U.S.P.Q. (BNA) 388 (1981)..

5 In light of the current amendments and the remarks made above, the Applicants believe that Claims 1, 15, and 29 in their currently amended form, are patentable over the combination of prior art references and respectfully request that this rejection of Claims 1, 15, and 29 under 35 U.S.C. §103(a) be withdrawn.

10 **Dependent Claims**

Claims 2-14 are dependent upon Claim 1, Claims 16-28 are dependent upon Claim 15, and Claims 30-42 are dependent upon Claim 29. For at least the reasons given above, the Applicants submit that Claims 1, 15, and 29 are patentable over the cited prior art. Therefore, in addition to the reasons set forth above, the Applicants submit that Claims 2-
15 14, 16-28, and 30-42 are also patentable over the cited prior art at least based on their dependence upon an allowable base claim.

Closing Remarks:

The Applicants respectfully submit that, in light of the above amendments/remarks, the application and all pending claims are now in allowable condition. Therefore, reconsideration is respectfully requested. Accordingly, early allowance and issuance of
5 this application is respectfully requested.

Any claim amendments that are not specifically discussed in the above remarks are not made for patentability purposes, and it is believed that the claims would satisfy the statutory requirements for patentability without the entry of such amendments. Rather,
10 these amendments have only been made to increase claim readability, to improve grammar, and to reduce the time and effort required of those skilled in the art to clearly understand the scope of the claim language. Furthermore, any new claims presented above are of course intended to avoid the prior art, but are not intended as replacements or substitutes of any cancelled claims. They are simply additional specific statements of
15 inventive concepts described in the application as originally filed.

Further, it should be noted that amendment(s) to any claim is intended to comply with the requirements of the Office Action in order to elicit an early allowance, and is not intended to prejudice Applicants' rights or in any way to create an estoppel preventing
20 Applicants from arguing allowability of the originally filed claim in further off-spring applications.

In the event the Examiner wishes to discuss any aspect of this response, or believes that a conversation with either Applicants' or Applicants' representative would be beneficial,
25 the Examiner is encouraged to contact the undersigned at the telephone number indicated below.

The Commissioner is authorized to charge any additional fees that may be required or credit overpayment to the attached credit card form. In particular, if this response is not
30 timely filed, the Commissioner is authorized to treat this response as including a petition

Reply to Office Action of July 13, 2007

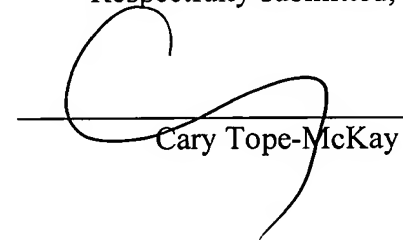
to extend the time period pursuant to 37 CFR 1.136(a) requesting an extension of time of the number of months necessary to make this response timely filed. The petition fee due in connection therewith may be charged to deposit account no. 50-2738 if a credit card form has not been included with this correspondence, or if the credit card could not be charged.

Respectfully submitted,

12/13/07

Date

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